DOCUMENT RESUME

ED 265 396 CE 043 410

AUTHOR Heiserman, Russell L.
TITLE Microcomputer Troubleshooting Training.
PUB DATE Dec 85
NOTE 17p.; Paper presented at the Meeting of the American Vocational Association (Atlanta, GA, December 6-10, 1985).
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Electromechanical Technology; *Electronics; *Electronic Technicians; *Equipment Maintenance; *Microcomputers; Postsecondary Education; *Program Development; Repair; Technical Education
IDENTIFIERS *Troubleshooting

ABSTRACT

The microcomputer troubleshooter is regarded as a technically knowledgeable member of the team and is more active in equipment selection, site preparation, site supervision and preventive maintenance, and on-site training of operators, maintenance people, and programmers. Microcomputer troubleshooting can be incorporated into an electronics program in two ways. Troubleshooting can be an area of study in a comprehensive electronics program or the goal of a specialized electronics program. The background study required for either path is the same, and coursework used to meet the first objective (a comprehensive electronics program) can also become part of the program with the second objective (specialized electronics program). A good foundation in basic electronics is essential. Troubleshooting microcomputer-based equipment may be broken into a basic and an advanced course. The basic course should use a single-board system, emphasize basic ideas, and introduce specialized instruments and techniques designed for computer troubleshooting. The advanced course should include a more complex system (multiboard system and disk drives), a more detailed study of the system, details of the system's operating system and common peripherals, and application of troubleshooting techniques and use of instruments covered in the basic course to troubleshoot the larger, more complex system. (YLB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

THIS PAPER PRESENTED DURING THE
1985 AVA CONVENTION, ATLANTA, GA

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)
This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

R Heiserman

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

MICROCOMPUTER TROUBLESHOOTING TRAINING

BY

RUSSELL L. HEISERMAN

ELECTRONICS/COMPUTER ENGINEERING TECHNOLOGY
OKLAHOMA STATE UNIVERSITY

ED265396

INTRODUCTION:

WE ARE IN A MICROCOMPUTER REVOLUTION. OUR CARS, APPLIANCES, AND THE VENDING MACHINES AT WORK "TALK" TO US. BOATS, PLANES, AND SOME AUTOMOBILES USE SATELLITE NAVIGATION. OUR KIDS PLAY WITH TOYS THAT ARE UNBELIEVABLY SMART. BILLIONS ARE BEING SPENT ON VIDEO GAMES. INTELLIGENT ROBOTS ARE HELPING TO INCREASE OUR INDUSTRIAL PRODUCTIVITY.

THE PROLIFERATION OF MICROCOMPUTER-BASED EQUIPMENT IS JUST BEGINNING. THERE IS ALREADY OVER 600,000 PERSONAL COMPUTERS IN OUR HOMES, AND THIS FIGURE WILL INCREASE TO OVER SIX MILLION BY 1990. ESSENTIALLY EVERY BUSINESS, REGARDLESS OF SIZE, WILL USE COMPUTERS OR

CE043410

COMPUTER SERVICES BY 1990. EVERY FACET OF OUR LIVES WILL CHANGE DRASTICALLY BEFORE THE END OF THE CENTURY.

THIS UNBOUNDED PROLIFERATION CREATES OPPORTUNITY FOR THOSE WELL TRAINED AS MICROCOMPUTER TROUBLESHOOTERS.

IN THIS PAPER I WILL DISCUSS:

1. THE GROWING RESPONSIBILITY OF THE MICROCOMPUTER TROUBLESHOOTER.

2. MODERN TROUBLESHOOTING TECHNIQUES.

3. HOW TO INCORPORATE MICROCOMPUTER TROUBLESHOOTING INTO YOUR ELECTRONICS PROGRAMS.

THE GROWING RESPONSIBILITY OF THE MICROCOMPUTER TROUBLESHOOTER:

IN LOWER TECHNOLOGY SITUATIONS, THE TROUBLESHOOTER WAS OFTEN RELEGATED TO A MINOR POSITION WITHIN A COMPANY. THIS IS CHANGING IN THE HIGH-TECH MICROCOMPUTER WORLD WE ARE CREATING. THE MICROCOMPUTER TROUBLESHOOTER IS REGARDED AS A TECHNICALLY KNOWLEDGEABLE MEMBER OF THE TEAM--OFTEN AN ACTIVE COMPUTERIST AS WELL AS BEING A TROUBLESHOOTER.

THE HIGH-TECH TROUBLESHOOTER IS MORE ACTIVE IN:

- EQUIPMENT SELECTION,
- SITE PREPARATION,
- SITE SUPERVISION AND PREVENTIVE MAINTENANCE,
- AND ON-SITE TRAINING.

Site Preparation.

Microcomputer equipment companies are slowly and painfully becoming aware that the installation site may be causing the lion's share of their warranty service calls. A significant problem area is the power distribution system. One field service company using trained power system test specialists found AC distribution problems in 65 percent of the sites tested. These problems were mechanical, easily found, and easily corrected by a trained specialist. The following is a partial list of the most common problems found. Keep in mind that these problems often occur in combination.

MISSING CONNECTIONS:

Open grounds,
Open neutrals,
Open hots,
Open neutral-ground bonding at the main service panel.

IMPROPER CONNECTIONS:

Hot and neutral reversed,
Hot and ground reversed,
Neutral and ground reversed,
Neutral and ground shorted at outlets,
Two hots in 120 VAC outlets.

POOR CONNECTIONS:

Poor or loose connections any place in the system.

IMPEDANCE LEVELS OF CONDUCTORS:

Neutrals and grounds.

SITE SUPERVISION AND PREVENTIVE MAINTENANCE.

SITE SUPERVISION INCLUDES SEEING THAT THE EQUIPMENT IS TREATED PROPERLY BY OPERATORS (WHO SPILLED THE COKE IN THE KEYBOARD?).

MAKING SURE THAT THE SPACE IS PROPERLY AIR CONDITIONED--THIS INCLUDES TEMPERATURE CONTROL AND THE REMOVAL OF CAUSTIC CONTAMINATES.

SITE SUPERVISION MAY INCLUDE INTRODUCING ELECTROSTATIC DISCHARGE (ESD) CONTROL PROCEDURES IN BOTH THE USER AREA AND THE REPAIR AREA. ESD CONTROL IS SLOWLY BEING RECOGNIZED AS A VERY IMPORTANT CONSIDERATION. THE TABLE LISTS SOME COMMON ACTIVITIES IN AN AIR CONDITIONED ENVIRONMENT WITH 10 TO 20 PERCENT HUMIDITY AND THE ELECTROSTATIC POTENTIALS GENERATED.

ACTIVITY	VOLTAGE
WALKING ACROSS A CARPET	35,000
WALKING ACROSS A VINYL FLOOR	12,000
WORKING AT A REPAIR BENCH	6,000
CERAMIC DIPS IN A VINYL TRAY	11,500
CERAMIC DIPS IN STYROFOAM	14,500
REMOVAL OF A CIRCUIT BOARD FROM BUBBLE PACK	26,000
CERAMIC DIPS IN A PLASTIC TUBE	2,000

WORKBENCH WITH ELECTROSTATIC PROTECTION

IN ADDITION TO SITE SUPERVISION, THE TROUBLESHOOTER WILL PROBABLY KEEP A JOURNAL OF REPAIR AND MAINTENANCE ACTIVITY DURING THE WARRANTY PERIOD. THIS JOURNAL WILL GUIDE THE IMPLEMENTATION OF A SOUND PREVENTIVE MAINTENANCE PROGRAM TO INSURE MINIMUM DOWN-TIME AND TO EXTEND THE USEFUL LIFE OF THE EQUIPMENT.

On-site training.

The troubleshooter will be more involved in on-site training of operators, maintenance people, and programmers. After the vendor training program is complete, there will be a period of lost data, mysterious results, and confused operations. It is a difficult period, so the troubleshooter will have to remember that no one benefits from a loss of temper--keep cool and be patiently helpful. This period of "cockpit" troubles will pass.

- IN-CIRCUIT EMULATION IS AN ADVANCED TECHNIQUE WHERE ONE COMPUTER LOADED WITH DIAGNOSTIC ROUTINES BECOMES THE TROUBLESHOOTERS PARTNER IN TROUBLESHOOTING A SECOND COMPUTER. THE HOST COMPUTER TAKES OVER THE TARGET COMPUTER; TESTS THE TARGET COMPUTER'S ROM AND RAM MEMORY AS WELL AS EXERCISING THE BUSES OF THE TARGET. THIS TECHNIQUE GREATLY AIDS THE TROUBLESHOOTER IN ISOLATING HARDWARE AND MEMORY PROBLEMS.

HOW TO INCORPORATE MICROCOMPUTER TROUBLESHOOTING INTO YOUR ELECTRONICS PROGRAM:

THERE ARE TWO APPROACHES:

1. TROUBLESHOOTING AS AN AREA OF STUDY IN A COMPREHENSIVE ELECTRONICS PROGRAM.
2. TROUBLESHOOTING AS THE GOAL OF A SPECIALIZED ELECTRONICS PROGRAM.

FORTUNATELY, THE BACKGROUND STUDY REQUIRED FOR EITHER PATH IS THE SAME, AND COURSEWORK USED TO MEET THE FIRST OBJECTIVE CAN ALSO BECOME PART OF THE PROGRAM WITH THE SECOND OBJECTIVE.

FOUNDATIONAL STUDIES.

A GOOD FOUNDATION IN BASIC ELECTRONICS IS ESSENTIAL, THE COURSEWORK SHOULD INCLUDE:

- BASIC CIRCUIT CONCEPTS (AC AND DC),
- SOLID-STATE CONCEPTS (DIODES, TRANSISTORS, AND ICS),
- DIGITAL CIRCUIT PRINCIPLES (LOGIC GATES, ETC.),
- USE OF INSTRUMENTS, EMPHASIZING PROPER USE OF THE OSCILLOSCOPE AND INCLUDING LOGIC PROBES AND PULSERS,

- INTRODUCTION TO MICROCOMPUTERS INCLUDING ARCHITECTURE AND MACHINE CODE PROGRAMMING. SHOULD USE A SIMPLE 8-BIT SYSTEM FOR THIS INTRODUCTION.

- PROPER SOLDERING AND DESOLDERING.

Basic troubleshooting to meet objective 1 and preparation for objective 2.

Basic troubleshooting should be introduced using a simple single-board system and should emphasize the basics. Topics should include:

- Basic computer organization (a review),
- Visual inspection and static testing using logic probes,
- Dynamic testing using more advanced troubleshooting techniques:
  - Use of diagnostic software,
  - Use of logic analyzers,
  - Use of in-circuit emulation.
- Review of common microcomputer troubles,
- Troubleshooting practice--diagnostic testing, selection of test technique, deducting the most probable cause, and repair. It is important to gain confidence.

Nothing can replace guided practice in troubleshooting. Practice develops the good deductive skills required of the successful troubleshooter.

The above topics can be covered in a semester or less--depending on the amount of preparation for the course and the structure of the particular program.

Advanced troubleshooting to meet objective 2.

The student should be introduced to a more complex system including:

- A multiboard system (card cage or motherboard),
- Disk drives,
- Full keyboard,
- CRT readout,
- Printer.

A more detailed study of the system and its components is important. This includes a board level analysis of each board making up the system, disk drive operation and maintenance including; speed adjustment and head alignment.

This study should also include the details of the system's operating system and expanded to include common peripherals.

After the analysis phase, time must be devoted to applying troubleshooting techniques and using instruments covered in the basic course to troubleshoot this larger, more complete system.

IT WOULD ALSO BE ADVISABLE TO INCLUDE SOME STUDY OF PROGRAMMABLE CONTROLLERS IN THIS COURSE.

A FULL SEMESTER OR MORE WILL BE NEEDED TO MEET THE OBJECTIVES OF THIS COURSE.

SUMMARY

WE ARE IN A MICROCOMPUTER REVOLUTION OF HOW WE DO THINGS IN BUSINESS, EDUCATION, AND INDUSTRY. THE NEED FOR WELL TRAINED TROUBLESHOOTERS OFFERS UNPRECEDENTED OPPORTUNITY FOR OUR GRADUATES.

A SOUND BACKGROUND IN BASICS IS REQUIRED FOR TROUBLESHOOTERS OF HIGH-TECH EQUIPMENT. THESE BASIC COURSES ARE PRETTY MUCH IN PLACE IN OUR PRESENT ELECTRONICS PROGRAMS.

TROUBLESHOOTING MICROCOMPUTER BASED EQUIPMENT MAY BE BROKEN INTO A BASIC AND AN ADVANCED COURSE. THE BASIC COURSE SHOULD EMPHASIZE BASIC IDEAS AND INTRODUCE SPECIALIZED INSTRUMENTS AND TECHNIQUES DESIGNED FOR COMPUTER TROUBLESHOOTING. THE ADVANCED COURSE SHOULD BE A BROADENING EXPERIENCE USING A MORE COMPLEX SYSTEM.

BUILDING CONFIDENCE THROUGH TROUBLESHOOTING PRACTICE IS THE AIM OF BOTH COURSES.

BIBLIOGRAPHY

GENERAL REFERENCES

Goody, Roy W., The Intelligent Microcomputer. Chicago, IL: SRA, Inc., 1982.

Rony, Peter R., Programming. New Haven,CT: E&L Instruments, Inc., 1982.

Rony, Peter R., Interfacing. New Haven,CT: E&L Instruments, Inc., 1982.

TROUBLESHOOTING REFERENCES

Coffon, James W., Practical Troubleshooting Techniques For Microcomputers. Englewood Cliffs,NJ: Prentice-Hall, Inc.,1981.

Crane, John, Laboratory Experiments For Microprocessor Systems. Englewood Cliffs,NJ: Prentice-Hall,Inc., 1980.

Heiserman, Russell L., Microcomputer Troubleshooting. New Haven, CT: E&L Instruments, Inc., 1984.

LOGIC AND SIGNATURE ANALYSIS REFERENCES

Blackmore, David J., "Logic Analysis," Computer/Electronics Service News, Dalton,MA: July/August 1984.

Instruction Manual for LA-1020 Logic Analyzer and SA-1010 Signature Analyzer. Chicago,IL: Dynascan Corp., 1981.

IN-CIRCUIT EMULATION REFERENCE

Fergusion, John D., "In-Circuit Emulation for the Apple II Computer," Hancock,NH: Byte, Vol. 8, No. 9, September 1983.